



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

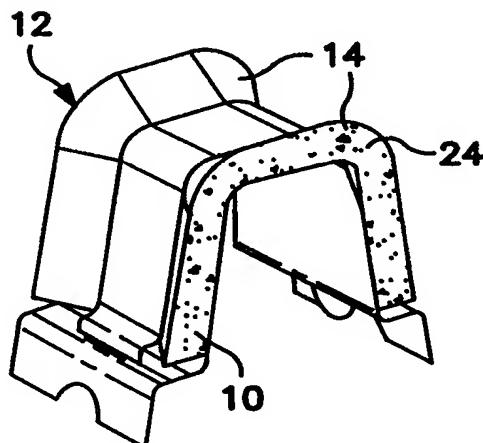
(51) International Patent Classification 6 :	A1	(11) International Publication Number: <b>WO 99/61719</b>
E04C 5/16		(43) International Publication Date: 2 December 1999 (02.12.99)

(21) International Application Number: PCT/US99/10441	(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
(22) International Filing Date: 18 May 1999 (18.05.99)	
(30) Priority Data: 60/086,496 22 May 1998 (22.05.98) US 09/257,920 26 February 1999 (26.02.99) US	
(71) Applicant: HENKEL CORPORATION [US/US]; Suite 200, 2500 Renaissance Boulevard, Gulph Mills, PA 19406 (US).	
(72) Inventor: WYCECH, Joseph, S.; 795 Hidden Lane, Grosse Pointe Woods, MI 48236 (US).	
(74) Agent: HARPER, Stephen, D.; Henkel Corporation, Suite 200, 2500 Renaissance Boulevard, Gulph Mills, PA 19406 (US).	

(54) Title: LAMINATE BULKHEAD WITH FLARED EDGES

## (57) Abstract

A laminate bulkhead comprises an expandable polymer (24) sandwiched between two stiff members (10) and (12) which are of a structure so that the expandable polymer (24) is flared out or thicker in the area or along the line where the polymer (24) expands and is bonded to the walls of a hollow structure in which the bulkhead is placed. The direction of expansion of the polymer (24) results from the polymer being constrained by the stiff members on either side of the expanding (24).



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav	TM	Turkmenistan
BF	Burkina Faso	GR	Greece		Republic of Macedonia	TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's	NZ	New Zealand		
CM	Cameroon		Republic of Korea	PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

## LAMINATE BULKHEAD WITH FLARED EDGES

### Background of the Invention

In various practices, such as the automotive industry it is desired  
5 to stiffen parts. For example, certain parts may have spaced walls and it would be desirable to have some reinforcement between the spaced walls. Ideally, such reinforcements should be easy to apply and should effectively function without adding significant weight to the hollow structure being reinforced.

### Summary of the Invention

10 An object of this invention is to provide a reinforcing structure for various parts, such as used in the automotive field.

A further object of this invention is to provide such a reinforcing structure which can be easily assembled without sacrifice to its effectiveness.

15 In accordance with this invention an expandable polymer material is sandwiched between two stiff or rigid members. Preferably when the polymer expands the resultant foam is flared out or is thicker in the area or along the line where the polymer expands into a rigid structural foam which bonds to the inside wall of the structural member that is being reinforced.

### The Drawings:

20 Figure 1 is an exploded view of a laminate bulkhead with flared edges in accordance with this invention;

Figure 2 is a perspective view of the bulkhead shown in Figure 1 in the assembled condition, but without the polymer layer;

Figure 3 is a view similar to Figure 2 after expansion of the polymer;

Figure 4 is a cross-sectional view in elevation of the bulkhead shown in Figure 3;

5 Figure 5 is a cross-sectional view taken through Figure 4 along the line 5-5 showing the laminate bulkhead mounted in a structural member;

Figure 6 is an end elevational view showing the polymer expanded into the flared edges of the bulkhead in the arrangement shown in Figures 1-5;

10 Figure 7 is a cross-sectional view taken through Figure 6 along the line 7-7; and

Figure 8 is a cross-sectional view taken through Figure 6 along the line 8-8.

#### **Detailed Description**

The present invention relates to providing a reinforcing structure through the use of a sandwich created by providing an expandable foam or polymer between two stiff layers. Such stiff layers could be of any suitable material such as metal, plastic or fiberglass which has sufficient rigidity. The invention may have various uses including, but not limited to, various automotive uses such as the uses of my Serial No. 08/675,173, filed July 3, 1996 and Serial 15 No. 09/103,032 filed June 23, 1998 and Serial No. 09/074,616, filed May 7, 20 1998, all of the details of which are incorporated herein by reference thereto. Preferably, the expandable polymer is heat expandable. The invention, however, may be practiced where the expansion is chemically activated.

In general, the invention involves having the expandable polymer flared out or thicker in the area or along the line where the polymer expands and bonds to the inside wall of the member that the bulkhead is reinforcing. The polymer is forced to expand in the plane of the bulkhead and is constrained by the stiff layers on either side of the expanding polymer. The result is to provide 5 an effective means of tying opposing walls of a hollow member to each other.

Where the invention is used in the automotive industry advantage could be had of various heating steps which are otherwise employed to cause activation of a heat expandable polymer. Alternatively, as noted above, the 10 expansion could result from means other than heating such as by chemical activation.

The drawings illustrate one practice of the invention which results in a laminate bulkhead 1 with flared edges. Figure 1 is an exploded view of a two piece stamping which includes a generally U-shaped inner rigid or stiff base member 10 and a generally U-shaped outer rigid or stiff cover member 12. Each member has downwardly extending legs interconnected by an intermediate portion. Outer member 12 includes a pair of outwardly diverging flared edges 14,14 connected by an intermediate or central generally U-shaped portion 16. U-shaped central portion 16 generally conforms in size and shape to the inner 15 base member 10 except that it is narrower than inner member 10 with each flared end 14 extending outwardly away from base member 10 and terminating in the same plane as the outer edge of member 10. See Figures 5 and 7. If 20 desired, the base member may also have flared edges similar to edges 14,14

which would terminate in the same plane as edges 14,14. Alternatively, members 10 and 12 may be reversed such that the cover member 12 has no flared edges, while base member 10 may have flared edges.

In the illustrated embodiment inner member 10 includes a slot 18  
5 on a horizontal shoulder of each leg of a size and shape to receive a tab 20 at the end of each leg of outer member 12. If desired, tabs 20 could have a locking element such as a dimple 22 to firmly connect inner member 10 and outer member 12 together and minimize any disconnection after the parts or members are snapped together. See, for example, Figures 4-7. Alternatively, base  
10 member 10 may include tabs fitting into slots in the cover member 12.

In accordance with this invention a layer of polymer material 24 is provided on either the inner surface of outer member 12 or the outer surface of inner member 10. Such foam material may be of the type disclosed in my aforesaid patent applications to function as a rigid reinforcement structural  
15 foam. The foam material 24 is applied to its carrier member 10 or 12 in unexpanded form. The inner member 10 and outer member 12 are then assembled together by insertion of the tabs 20 into the corresponding slots 18. Upon activation of the foam, such as from the heat encountered in an e-coating which is conventionally done in automotive manufacturing, the foam expands  
20 into intimate contact with both the inner surface of outer member 12 and outer surface of inner member 10. Because of the geometry of the two outer layers 10,12 the expanded foam is flared out or thicker in the area or along the line where the polymer expands and is bonded to the inside walls 26,26 of a hollow

structural member that the bulkhead is reinforcing. The polymer is forced to expand in the plane of the bulkhead and is constrained by the stiff layers 10,12 on either side of the expanding polymer. This action is illustrated in various figures. The result of the invention is to provide an effective means of tying 5 opposing walls 26,26 of a hollow member to each other. Figure 5, for example, illustrates the polymer 24 spaced inwardly before expansion. Figure 7, however, shows the polymer 24 expanded into a structural reinforcement foam intimately bonded to the walls 26,26 as well as the member 10,12.

Because members 10,12 are locked together, the spacing between 10 them is fixed. Thus, polymer 24 is disposed in a rigid channel. Accordingly, when polymer 24 expands it is restrained from moving in a thickness direction and is forced to move outwardly toward the edges of members 10,12, thus assuring making intimate bonding contact with walls 26,26.

Although the drawings illustrate a preferred practice of the 15 invention, the invention may be practiced in other manners. For example, the base member and cover member could be locked together to form a saddle without either member being flared and with the members being completely parallel to each other over most of their area. This arrangement would still have the advantage of forcing the foam to expand laterally. The figures illustrate the 20 bulkhead 1 to be shaped to fit in a channel having parallel sides, such as sides 26,26 in Figures 5 and 7. The channel and the bulkhead, however, could have other shapes wherein the bulkhead conforms to channels with other wall relationships, such as outwardly tapered walls. Where the bulkhead is in a

tapered channel the end edges of both members are preferably coplanar with the plane at the angle of the tapered channel. Where the channel has an irregular shape, the end edges would preferably conform to the irregular shape and need not be coplanar.

5            Although the invention has been described with respect to reinforcing automotive structural members, the invention may be practiced in other fields where such a reinforcement would be desirable.

**What is Claimed is:**

1. A laminate bulkhead comprising a stiff base member, a stiff cover member mounted over and spaced from said base member, one of said members having end edges flared outwardly away from the other of said members, each of said members having a central portion, said members being located closer to each other at said central portions than at said flared edges, a structural reinforcement foam located between and bonded to said base member and said cover member, said structural reinforcement foam being formed from an expandable polymer, and said members constraining the direction of expansion of said expandable polymer whereby said structural reinforcement foam is thicker at said flared ends than at said central portions.
2. The laminate bulkhead of claim 1 wherein said base member and said cover member terminate in end edges which are coplanar with each other on both sides of said central portions.
3. The laminate bulkhead of claim 2 wherein the spacing between said central portions is uniform.
4. The laminate bulkhead of claim 3 wherein said base member and said cover member are interlocked to maintain the spacing between them fixed.
5. The laminate bulkhead of claim 4 wherein said base member has said flared edges.

6. The laminate bulkhead of claim 4 wherein said polymer is heat expandable.
7. The laminate bulkhead of claim 4 wherein said one of said members has said end edges flared outwardly on each side of said central portion.
8. The laminate bulkhead of claim 7 wherein one of said members includes a tab which fits into a slot in the other of said members to interlock said members together.
9. The laminate bulkhead of claim 8 wherein said base member and said cover member are each generally U-shaped having downwardly extending legs and an upwardly located connecting portion between said legs, and each of said downwardly extending legs including said interlocking tab/slot structure.
10. The laminate bulkhead of claim 9 wherein said base member has a generally horizontal shoulder on each of its legs, one of said slots being in each of said horizontal shoulders, and each of said legs of said cover member having a downwardly extending tab for fitting in its respective said slot.
11. The laminate bulkhead of claim 10 including a dimple on each of said tabs for minimizing the tendency of said tabs to be removed from said slots.
12. The laminate bulkhead of claim 11 in combination with a hollow member having a pair of spaced walls, said laminate bulkhead

being disposed in said hollow member with said end edges of each of said members being disposed against said walls, and said structural foam being intimately bonded to said members and to said walls.

5        13. The laminate bulkhead of claim 1 in combination with a hollow member having a pair of spaced walls, said laminate bulkhead being disposed in said hollow member with said end edges of each of said members being disposed against said walls, and said structural foam being intimately bonded to said members and to said walls.

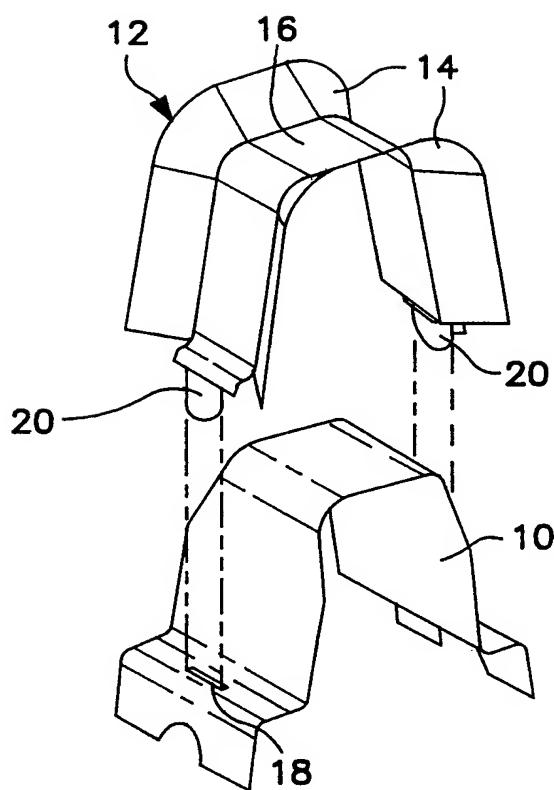
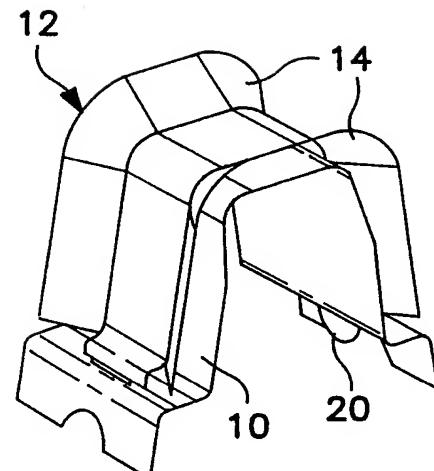
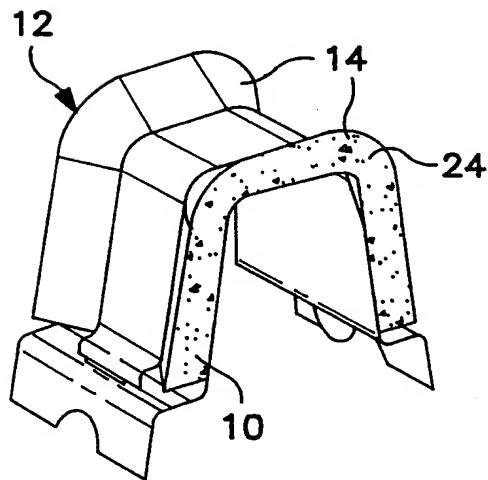
10       14. A laminate bulkhead comprising a stiff base member, a stiff cover member mounted over and spaced from said base member, each of said members having a central portion disposed between end edges, a structural reinforcement foam located between and bonded to said base member and said cover member, said structural reinforcement foam being formed from an expandable polymer, and said base member and said cover member being interlocked to maintain the spacing between them fixed and to constrain the direction of expansion of said expandable polymer when said polymer expands so that said expandable polymer may only expand laterally.

15

20

15. The laminate bulkhead of claim 14 wherein said base member and said cover member are parallel to each other at said central portions and at said end edges.
16. The laminate bulkhead of claim 15 wherein each of said base member and said cover member is generally U-shaped whereby said laminate bulkhead is generally saddle shaped.
17. A method of reinforcing a structural member having a pair of spaced walls comprising the steps of providing a stiff base member having a central portion and an end portion on each lateral side of the central portion, providing a layer of expandable polymer on the central portion, mounting a stiff cover member over the layer of polymer and underlying base member, interlocking the cover member and the base member to each other to form a rigid channel which constrains and directs the outward movement of the polymer upon expansion into a structural reinforcing foam, one of the base member and cover member having outwardly flared edges at each of its end portions, mounting the bulkhead laminate created by the interlocking of the base member and cover member together with the polymer therebetween into the hollow structural member with the ends of the bulkhead laminate being in contact with the spaced walls, and expanding the polymer into a rigid structural reinforcement foam which is intimately bonded to the spaced walls and to the cover member and base member.

18. The method of claim 17 including heating the bulkhead laminate to cause expansion of the foam.
19. The method of claim 17 wherein one of the base member and cover member contains a slot and the other of the base member and cover member contains a tab, and interlocking the base member and the cover member together by snapping the tab into the slot.  
5
20. The method of claim 19 wherein the laminate bulkhead is of generally U-shaped form with each of the base member and the cover member having downwardly extending legs connected by an intermediate portion, each of the legs of the base member having a horizontal shoulder with a slot in each of the shoulders, each of the legs of the cover member terminating in a downwardly extending tab, and inserting the tabs on each leg of the cover member into a corresponding slot in each leg of the base member.  
10
21. The method of claim 17 wherein the polymer is confined to the central portions of the bulkhead laminate before expansion.  
15

**FIG. 1****FIG. 2****FIG. 3**

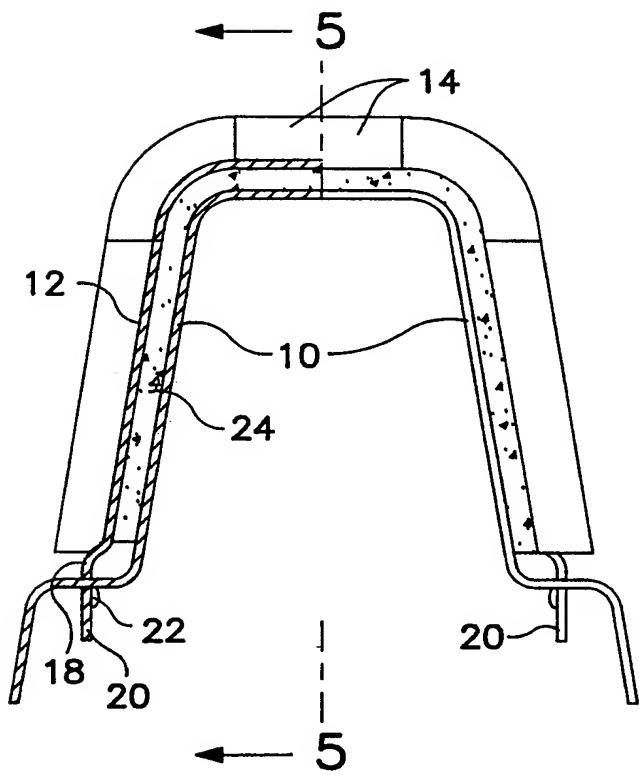


FIG. 4

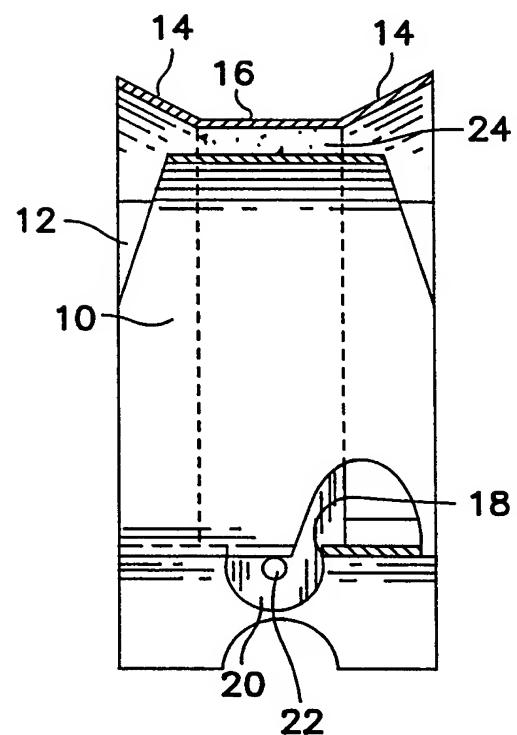


FIG. 5

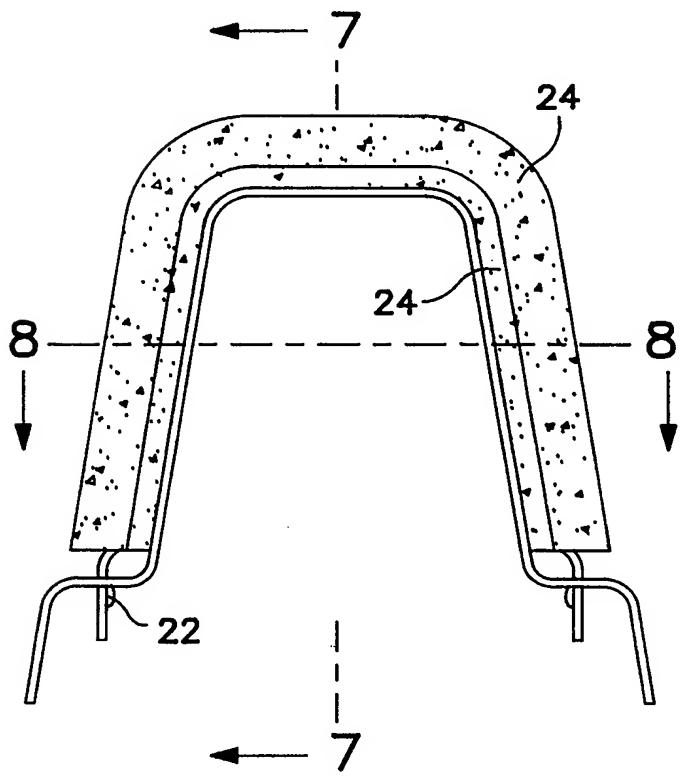


FIG. 6

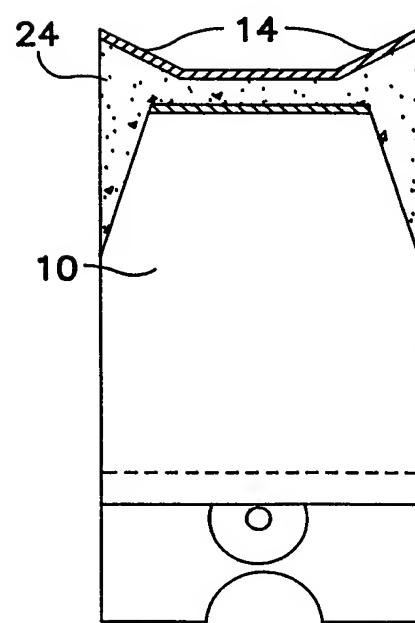
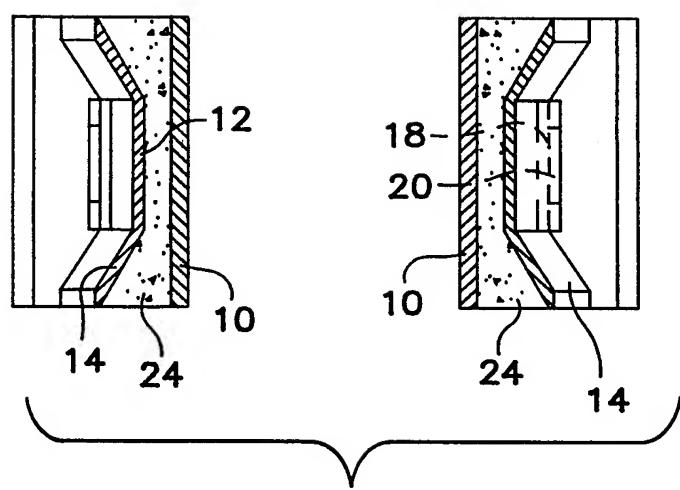


FIG. 7



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/10441

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : E04C 5/16

US CL : 52/731.6, 783.1, 309.8; 296/187, 191, 205, 203.01, 204

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 52/731.6, 783.1, 309.8; 296/187, 191, 205, 203.01, 204

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,213,391 A (TAKAGI) 25 May 1993 (25.05.93), Figure 9.	1
---		---
Y		14
A	US 5,652,039 A (TREMAIN ET AL.) 29 July 1997 (29.07.97).	
A	US 3,757,559 A (WELSH) 11 Sept 1973 (11.09.73).	
A	US 4,440,434 A (CELLI) 03 April 1984 (03.04.84).	

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance		
*B* earlier document published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*O* document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
*P* document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

18 JUNE 1999

Date of mailing of the international search report

03 AUG 1999

Name and mailing address of the ISA/US  
Commissioner of Patents and Trademarks  
Box PCT  
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer  
JENNIFER I. THISSELL

Telephone No. (703) 308-2168